

## Two new species of *Leptochiton* Gray, 1847 (Polyplacophora) from the Iberian Peninsula (eastern Atlantic coast)

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### ABSTRACT

Two new species of the genus *Leptochiton* (Polyplacophora) from the Atlantic Ocean are described: *Leptochiton* (*Leptochiton*) *truncosoi* and *Leptochiton* (*Leptochiton*) *pepezamorai* were collected off Spain at 753–832 m depth. Both species have been included in genus *Leptochiton*, subgenus *Leptochiton*, due to the presence of thin valves without insertion plates, tegmentum finely granulated with granules of equal size, and the dorsal girdle covered with small scales. The new species are characterized by their elongate-oval shape, tegmentum sculptured with thin rounded granules, which tend to form strings, and girdle dorsally covered with long, non-imbriate scales. The larger lateral tooth of the radula is bicuspid in *L. (L.) truncosoi*, and unicuspid in *L. (L.) pepezamorai*. Among all the known species of *Leptochiton*, the new species are more similar to *L. (L.) xanthus*, *L. (L.) tenuis*, *L. (L.) geromenis* and *L. (L.) thalattis*. In this paper the anatomic features of the new species are compared with all the species of *Leptochiton*.

### INTRODUCTION

The species of the genus *Leptochiton* Gray, 1847, have been revised by Kaas (1979, 1981, 1991), Van Belle (1983), Kaas and Van Belle (1985, 1987, 1990, 1994), Dell'Angelo and Palazzi (1991, 1986, 1987), Della Bella and Dell'Angelo (1985), Cesari (1987), and Carmona and Urgorri (1999). These studies allow us to determine the actual worldwide diversity of *Leptochiton*. Nevertheless, some specimens collected off northwestern Spain have features that differ from those of the species described in these previous works. We describe herein, using light and scanning electron microscopes, two new species of *Leptochiton* based on their distinctive shell, radula, and girdle scales.

### MATERIALS AND METHODS

The specimens were collected in 1990–1991 during the “CANGREXO I” campaign off A Quiñiela (Galicia, north-

western Spain) between 753–832 m depth. The specimens were collected using royal crab (*Chaceon affinis*) traps. They were preserved in 70% ethanol. To study the hard parts (shells, scales, girdle spicules, and radulae) the animals were macerated in 10% KOH and rinsed with distilled water. For SEM (Philips XL-20), shells, radulae, and girdle scales were coated with gold. MNCN stands for Museo Nacional de Ciencias Naturales, Madrid, Spain.

### SYSTEMATICS

Class Polyplacophora Gray, 1821  
Order Neoloricata Bergenhayn, 1955  
Suborder Lepidopleurina Thiele, 1910  
Family Leptochitonidae Dall, 1889  
Genus *Leptochiton* Gray, 1847 (Type species: *Chiton cinereus* Montagu, 1803, non Linnaeus, 1767).

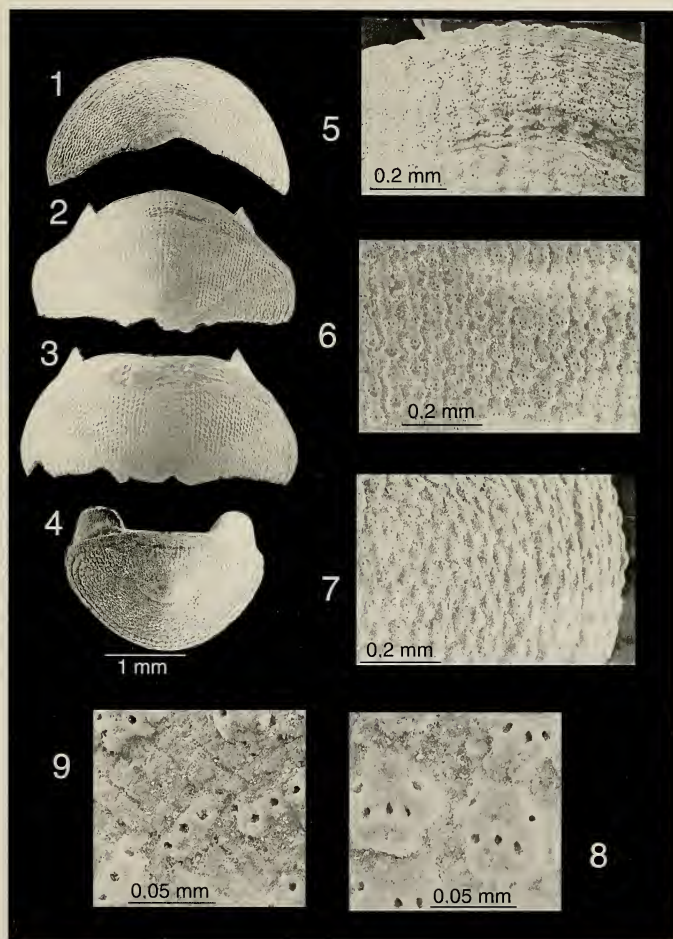
**Diagnosis:** Valves thin, lacking insertion plates and tegmentum finely granulated. The granules are of equal size and the girdle is dorsally covered with small scales.

*Leptochiton* (*Leptochiton*) *truncosoi* new species  
(Figures 1–20)

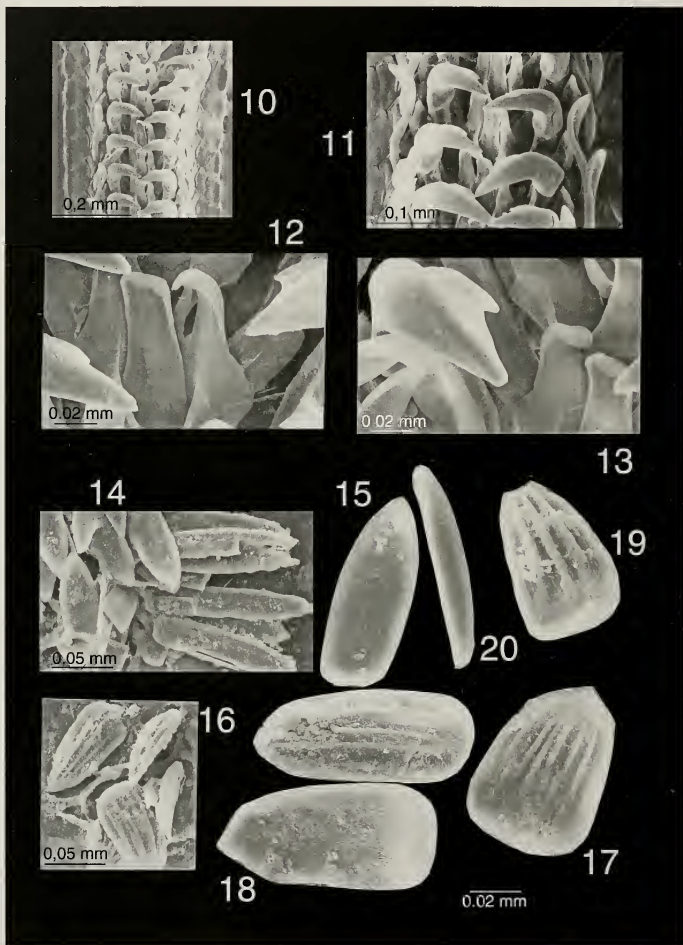
**Diagnosis:** Elongate-oval shape, twice as long as wide, moderately elevated, the back is evenly rounded and with a marked apex. The color of tegmentum is dark beige. The tegmentum is sculptured with thin rounded granules that tend to form strings among which semi-circular and concentric growth lines of the shell are shown. The girdle is narrow, covered with long non-imbriate scales. The major lateral tooth of the radula is bicuspid, and the internal cusp is small.

**Description:** The head valve has a semicircular anterior border whereas the posterior valve forms such a blunt angle that it hides the notch of the concave apex. The strong slope originated at the head valve is convex (Figure 1). The intermediate valves have rectangular borders except for the second valve, whose anterior mar-

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**Figures 1–9.** *Leptochiton (L.) troncosi*. **1.** Valve I. **2.** Valve II. **3.** Valve IV. **4.** Valve VIII. **5.** Arrangement of granules on jugal area. **6.** Arrangement of granules on pleural area. **7.** Arrangement of granules on lateral area. **8.** Arrangement of megalaesthets and micraesthets on central area of the granules. **9.** Arrangement of megalaesthets and micraesthets on lateral area of the granules.



Figures 10–20. *Leptochiton (L.) troncosoi*. 10–11. Radula. 12. Central and first lateral radular teeth. 13. Cusp of the major lateral tooth and spatulate uncinial tooth. 14. Arrangement of ventral scales and marginal spicules. 15. Ventral scales. 16. Arrangement of dorsal scale. 17. Dorsal scale, dorsal view. 18. Dorsal scale, ventral view. 19. Dorsal corpuscle. 20. Marginal spicules.

gin is completely convex (Figures 2, 3). However, in the remainder of valves it tends to be convex although it may be slightly concave in the jugal sinus. The lateral borders are rounded while the posterior borders are straight; they converge on the apex, and a little concave curvature is noticeable on both sides. The lateral areas are not raised, but are only visible on the sculpture. The tail valve is smaller in size than the head valve. The anterior margin of the caudal valve is similar to the intermediate valves and the semicircular posterior border. It has a prominent mucro at an antero-central position, which forms a strong slope (Figure 4).

The tegmentum has rounded granules forming a stem-like sculpture. The granules form parallel longitudinal strings in the central area (Figure 2). The granules are wider and flattened in the jugal area, and exhibit an apical stem divided into three parts that are usually connected to the next granule (Figure 6). On the pleural area, the granules are longer and the stems are smooth. The number of strings on the central area may be between 63 and 67 in the intermediate valves. At the head valve, lateral areas, and postmucral area, the strings are radially oriented (Figures 1, 2, 3, 4). The granules on both terminal valves are rounded with no stems (Figure 5), while on the lateral areas the shape is wider (Figure 7); arranged on a radially striate tegmentum, three striations are found on each granule. Eighty-nine strings are observed on the head valve, 58 on the tail valve, and 11–14 on the lateral areas.

The aesthetes are arranged in groups of five on each granule, although sometimes only three aesthetes may be seen (Figures 8, 9). They are situated at the edges of the granules except for the central one, which is located in a subcentral position on the granule.

The articulation is white, has fragile appearance, and lacks insertion plates. The apophyses are widely separated by the large jugal sinus. It has triangular shape on the intermediate valves and is trapezoidal with rounded edges on the tail valve.

The dorsal girdle is covered with slightly convex, elongate, curved, pointed scales, up to  $90 \times 53 \mu\text{m}$  each (Figure 16). They are sculptured with about 5–8 longitudinal ribs (Figures 17–19). Along the marginal there is a fringe of stronger cylindrical spicules up to  $200 \mu\text{m}$  in length (Figure 14). Ventrally the girdle is lined with triangular scales of  $20\text{--}28 \mu\text{m}$ ; scales become more elongate ( $70\text{--}120 \mu\text{m}$ ) and weakly ribbed toward the outer margin.

The gills are arranged in rows at both sides of the foot. They are inserted at the level of valve VII, extend to the anus with a gradual increase in size, but size decreases at the last valve. Thus, the gills are classified as merobranchial abanal without interspace. The number of gills on each side is 7.

The central tooth of the radula has rectangular shape with a narrow flexible blade (Figure 12). The first lateral tooth, with a similar appearance to the central tooth, exceeds this one slightly (Figure 12). The major lateral tooth is strongly developed in bicuspid form, with the

internal cusp being clearly smaller than the outer cusp (Figure 13).

**Holotype:** MNCN 15.03/482,  $8.5 \times 3.8 \text{ mm}$ , 1990, "CANGREXO I" expedition. Four valves and the radula were used for SEM, while the rest of the specimen was preserved in alcohol 70%; holotype is the only specimen known.

**Type Locality:** Off A Quiñela, Galicia, northwestern Spain,  $43^{\circ}17'22''\text{--}43^{\circ}18'52'' \text{ N}$ ,  $09^{\circ}36'38''\text{--}09^{\circ}35'45'' \text{ W}$ , 753–832 m depth ["CANGREXO I" expedition]. It was found between 753–832 m. The type locality is in an area with strong currents, and the holotype was found attached to a rock from a bottom with ferromanganese nodules, calcareous plaques, and coal slag.

**Distribution:** *Leptochiton (L.) troncosoi* is a deep-water species, known only from the type locality, off A Quiñela (Galicia, NW Spain).

**Etymology:** The species has been named *Leptochiton (Leptochiton) troncosoi* in honor of Dr. Jesús S. Troncoso.

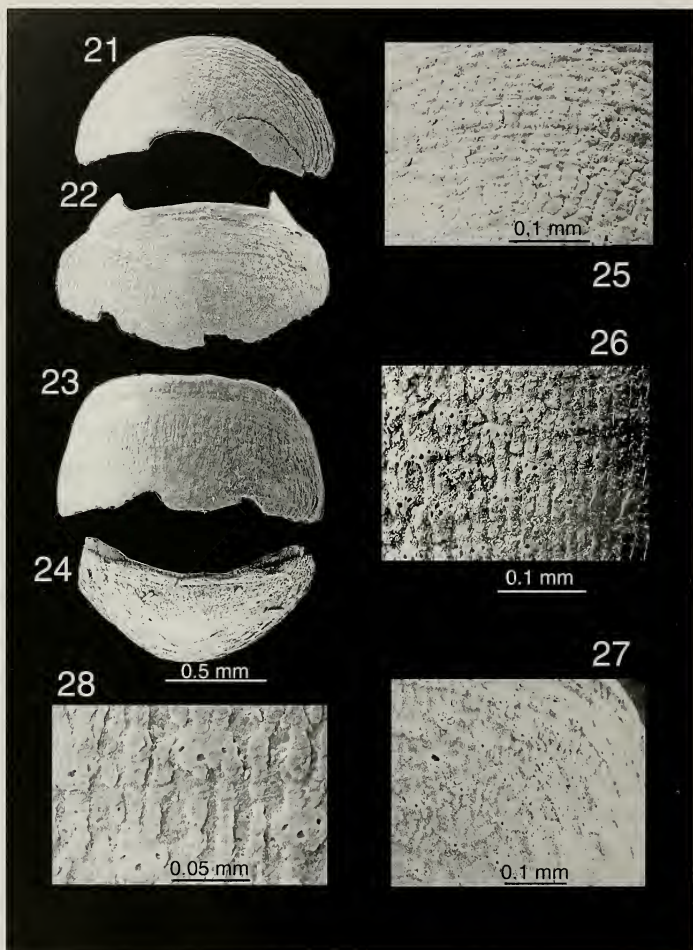
*Leptochiton (Leptochiton) pepezamorai* new species (Figures 21–38)

**Diagnosis:** Characterized by elongate oval shape, dorsal region evenly rounded, not careened, and without a marked apex. The tegmentum is white, although an ochre-oxide coloration is sometimes present. The tegmentum is sculptured with rounded granules. Two or three stems reach along the frontal area to the basal area of the adjacent granule. This creates some furrows on the tegmentum interrupted by the granules and concentric growth lines. The girdle is narrow, covered with rectangular non-overlapping scales. The major lateral tooth of the radula is unicuspid. The spatulate tooth is well developed and it exceeds the major lateral tooth.

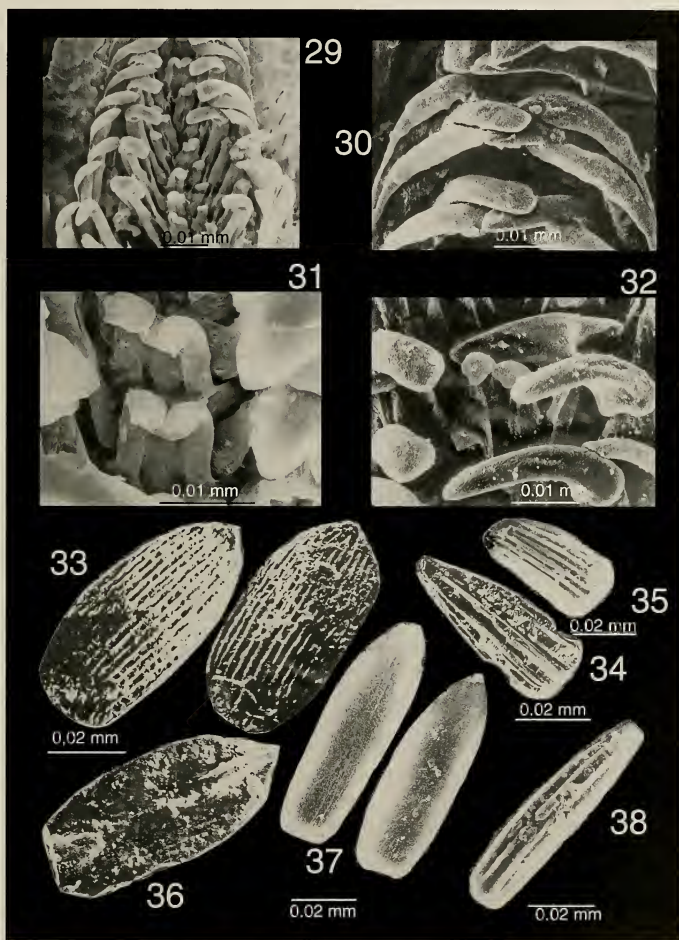
**Description:** The head valve has a semicircular anterior border and the posterior border has a little notch on the apex. The valve presents a strong convex slope (Figure 21). The intermediate valves, clearly rounded in their sides, are dorsally rectangular, except for the second valve, which has a triangular shape. The anterior border of this area is slightly convex, almost straight. The anterior and posterior borders of the remainder of the valves are straight. The lateral areas are not raised, only marked by a change in sculpture (Figures 22, 23). The tail valve is roughly triangular with size similar to the head valve. The mucro is antero-central, prominently marked where the originated slope is slightly convex (Figure 24).

The tegmentum is sculptured with rounded granules and two or three stems on the apical zone, showing a more or less concentric arrangement on the head valve, lateral areas, and postmucral area (Figures 25, 27). On the central areas, the granules are arranged in longitudinal rows separated by shallow grooves. The number of rows varies between 56 and 67.





Figures 21-28. *Leptochiton (L.) pepeزامorai*. 21. Valve I. 22. Valve II. 23. Valve IV. 24. Valve VIII. 25. Arrangement of pustules on jugal area. 26. Arrangement of pustules on pleural area. 27. Arrangement of pustules on lateral area. 28. Arrangement of megal aesthetes and micro aesthetes on pustules.



**Figures 29–38.** *Leptochiton (L.) pepeazaroi*. 29. Radula. 30. Spatulate uncinial tooth. 31. Central and first lateral teeth. 32. Cusp of major lateral tooth and spatulate uncinial tooth. 33. Dorsal scale. 34–35. Dorsal corpuscles. 36. Ventral scale, dorsal view. 37. Ventral scales, ventral view. 38. Marginal spicules.

As a general rule, the stems give striated aspect to the tegmentum, and are interrupted by the granules. In addition, the lateral areas, head valve, and postmucral area always show a variable number of growth marks. Each granule bears three aesthetes. The megal aesthete is located in a central-basal position while the microaesthetes are articulated in an upper level at both sides.

The articulation is white, lacking insertion plates. The apophyses are triangular in shape in the intermediate valves and trapezoid in the tail valve. The wide jugal sinus separates them.

The dorsal girdle is lined with pointed, rectangular, slightly curved scales. They are sculptured with 14 to 16 longitudinal grooves (Figure 33). Their size range is 40–62  $\mu\text{m}$  in length and 25–40  $\mu\text{m}$  on the base. Scattered among these scales are smaller ones, up to 47  $\mu\text{m}$  in length, with 8 longitudinal ribs. Also, the girdle has smooth dorsal spicules up to 160  $\mu\text{m}$  in length. The sharply rectangular ventral scales, up to 65  $\mu\text{m}$  in length, have a weak median, longitudinal rib up to 110  $\mu\text{m}$  in length (Figure 36). The marginal fringe shows pointed conic spicules, which are sculptured with 4 longitudinal ribs (Figure 35). Another, less abundant, type of spicules is present. These have three longitudinal ribs up to 54.4  $\mu\text{m}$  in length.

The gills are located at both sides of the foot, extending from valve VIII to the anus; the gills are classified as merobranchial abanal without interspace.

The central tooth of the radula is rectangular having a well-defined flexible edge. The first lateral tooth, similar in shape to the central tooth, also has a well-defined flexible terminal edge, and exceeds the central tooth slightly in length (Figures 29 and 31). The major lateral tooth is unicuspid with a slightly blunt edge (Figure 29). The spatulate uncinial tooth exceeds the major lateral tooth (Figure 30).

**Type Material:** Holotype: MNCN 15.03/484, 1.4  $\times$  0.7 mm; Paratype 1, from type locality, Animal Biology Department, Santiago de Compostela University unnumbered, 2.4  $\times$  1.3 mm; Paratypes 2, 3, Animal Biology Department, Santiago de Compostela University unnumbered, 1.75  $\times$  1.2 mm and one broken specimen, "CANGREXO I" Expedition, 43°23'31" N; 19°32'19" W, 840 m depth.

**Type Locality:** 43°17'18" N, 09°36'35" W, 753–786 m depth. A strong current was present in the area. The specimens were attached to a rock from a bottom with ferromanganese nodules, calcareous plaques, and coal slag.

**Distribution:** *Leptochiton* (*L.*) *pepezamorai* is known only from the type locality, A Quiñela (Galicia, NW Spain). It is a deep-water species, found in a depth of 753–840 m.

**Etymology:** The species has been named *Leptochiton* (*Leptochiton*) *pepezamorai* in honor of Mr. José Zamora.

## DISCUSSION

According to the diagnoses given by Kaas and Van Belle (1985) for the genus and subgenus, the species described in this paper are classified in genus *Leptochiton*, subgenus *Leptochiton*.

Both new species differ from the species of *Leptochiton* from the western Atlantic Ocean, South Africa, Pacific, and Indo-Pacific Oceans by the sculptures of their tegmentum, girdle scales, and the number of cusps of their major lateral radular teeth (Kaas and Van Belle, 1985, 1987, 1990, 1994).

Among all the species of *Leptochiton* worldwide, the only one that is considered cosmopolitan is *L. alveolus* (Lovén, 1846) (Kaas and Van Belle, 1985), since it occurs in the Atlantic, Pacific, and Indian Oceans. It differs from *L. (L.) troncosoi* and *L. (L.) pepezamorai* by the sculpture of the tegmentum and by the scales of the girdle.

According to the descriptions of Kaas (1979, 1981, 1991), Kaas and Van Belle (1985, 1987, 1990, 1994), Dell'Angelo and Palazzi (1987, 1991), Cesari (1987) and Carmona and Urgorri (1999), *L. (L.) troncosoi* and *L. (L.) pepezamorai* differ from the remaining species from the Eastern Atlantic Ocean and Mediterranean Sea by the features below.

In relation to the animal shape, four types have been described: oviform, oblong, oval and elongate oval. *L. (L.) troncosoi* and *L. (L.) pepezamorai* are allocated in the fourth type together with *L. alveolus*, *L. cancellatus* (Sowerby II, 1840), *L. cimicoides* (di Monterosato, 1879), *L. scabridus* (Jeffreys, 1880), *L. intermedius* (von Salvini-Plawen, 1968), *L. leloupi* Kaas, 1979, *L. tenuis* Kaas, 1979, *L. sarsi* Kaas, 1981, *L. gascognensis* Kaas and Van Belle 1985, *L. thalattius* Kaas and Van Belle, 1985, *L. geronensis* Kaas and Van Belle, 1985, *L. bedullii* Dell'Angelo and Palazzi, 1986, *L. xanthus* Kaas and Van Belle, 1990, *L. pseudogloriosus* Strack, 1991, and *L. compostellanum* Carmona and Urgorri, 1999.

Of all these species, only *L. tenuis*, *L. thalattius*, *L. geronensis*, *L. xanthus*, and *L. bedullii* have the tegmentum sculptured with granules arranged in longitudinal rows on the central area, and the dorsal scales of the girdle are longer than wide, like in *L. troncosoi* and *L. pepezamorai*.

In relation to the number of cusps of the major lateral teeth of the radula, *L. tenuis* and *L. xanthus* are similar to *L. pepezamorai* and *L. geronensis* is similar to *L. troncosoi*. The radula of *L. thalattius* Kaas and Van Belle (1985) has not been described, but this species differs from *L. pepezamorai* because the tegmentum is not furrowed and the dorsal scales of the girdle are bigger and have a smaller number of ribs.

*Leptochiton thalattius* differs from *L. troncosoi* by the sculpture of the tegmentum because in the former the central area of the jugal area has about eight parallel rows, is weakly developed, the four or five adjoining rows on the pleurae are curved as result of short interpolated rows (posteriorly as well as anteriorly), the re-

maining pleural rows are parallel, somewhat diverging toward the anterior (Kaas and Van Belle, 1985). The sculpture of *L. troncosoi* has parallel and longitudinal strings on the central area. Besides this, the girdle is dorsally covered with erect scales; among them, calcareous spicules occur and intersegmental spines are found. The scales of *L. troncosoi* are curved and they do not present either dorsal spicules or intersegmental spines.

Comparing *L. pepezamorai* to *L. tenuis*, according to Kaas (1979), the tail valve is much smaller than the other valves, while that of *L. pepezamorai* is of a similar size. The dorsal scales of the girdle of *L. tenuis* are bigger and they have a smaller number of ribs, and the cusp of the major lateral is sharply pointed. In relation to *L. xanthus*, following the description of Kaas and Van Belle (1990), the dorsal scales of the girdle are of smaller size and they have a smaller number of ribs, they lack dorsal spicules and the cusp of the major lateral tooth is sharply pointed.

Taking into account the description of *L. geronensis* by Kaas and Van Belle (1985) it differs from *L. troncosoi* by the tegmentum sculpture of round granules, which are very separated and by having the two cups of the major lateral tooth of similar size.

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